National Park Service
U.S. Department of the Interior

Western Arctic National Parklands
Kotzebue, Alaska

ABUNDANCE SURVEY OF DALL'S SHEEP IN THE WESTERN BAIRD MOUNTAINS, ALASKA, JULY 2004

Brad S. Shults

Technical Report NPS/AR/NRTR-2004-46

The National Park Service, Alaska Region
Natural Resource Reports

The Alaska Region of the National Park Service manages 16 areas in Alaska. The diversity of areas and their resources is reflected in their designation as national parks, monuments, preserves, and historical parks. These 16 areas represent more than 50 percent of the total acreage the National Park Service administers. The Alaska Region's Resource Management Program directs scientific research and resource management programs in a wide range of biological, physical, and social science disciplines.

The National Park Service disseminates reports on high priority, current resource management information, with managerial application, through the Alaska Region's Natural Resource Report Series. Technologies and resource management methods; resource management papers; proceedings of conferences and resource management workshops; and natural resource management plans are also disseminated through this series. Documents in this series usually contain information prepared primarily for internal use within the National Park Service.

Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the National Park Service.

To order a copy from the National Park Service, use the reference number on the report's title page. Copies of this report are available from the following:

National Park Service
Western Arctic National Parklands
P.O. Box 1029
Kotzebue, Alaska 99752
907-442-3890

or

National Park Service
Alaska Regional Office
240 West 5th Ave. RM 114
Anchorage, Alaska 99517

INTRODUCTION

Dall's sheep (*Ovis dalli dalli*) populations in northwestern Alaska declined precipitously following two severe winters in 1988-1989 and 1990-1991 (Fig. 1). In the western Baird Mountains, estimates of adult sheep, based on annual, fixed-wing surveys in a 1,828 km² area, declined by 53% from 736 adults in 1989 to 347 adults in 1991 (Fig. 2). Population counts remained low throughout 1991-96, declining to 244 adult sheep in 1996 (Fig. 2). Productivity and recruitment were also low during 1991-1994. Low sheep abundance resulted in closures for both state general and federal subsistence hunting seasons in the Baird Mountains area of wildlife management Unit 23 from 1991-1994. Subsistence hunting seasons on Federal public lands have been restored with harvest quotas since 1995. State hunting seasons have been closed since 1991 in the Baird Mountains because the harvestable surplus of sheep has been allocated to the Federal Subsistence hunt.

STUDY AREA

Noatak National Preserve encompasses 26,600 km² in the western Brooks Range and is bisected by the Noatak River valley (Fig. 3). The preserve is bounded on the north by the Delong Mountains and on the south by the Baird Mountains. The Baird Mountains separate the Noatak and Kobuk River valleys and extend east from the headwaters of the Agashashok and Eli Rivers to the Redstone and Ambler Rivers. Topography and vegetation is characterized by rolling tussock tundra interspersed with knolls and mountains reaching 700-915 m in elevation (Ayres 1986). The survey area encompasses 1,828 km² and is divided into 18 survey units (Fig. 3). Dall's sheep density is highest in the Maiyumerak Mountains , east to the Nakolik River, and south to the headwaters of the Squirrel River. Sheep also inhabit other areas in the Baird Mountains but their distribution is patchy and at a lower density than the survey area (Singer et al. 1983).

SURVEY METHOD

Since 1986, the abundance of sheep has been annually estimated in the survey area by fixed-wing surveys with no correction for visibility bias or estimates of precision (Dau 1993) (Appendix 1). Fixed-wing, tandem seat aircraft (e.g. super cub, scout, husky) with the pilot and one observer have been the only type of aircraft used for the surveys. Surveys were scheduled to be completed within 3 days in early July, following formation of post-lambing aggregations. Survey flights were primarily conducted between 0600 and 1300, but occurred later if wind and ceiling conditions were favorable (i.e. ceiling >1,200 m and wind speed <30 km/hr). Each pilot-observer team attempted to survey 3 different units per day. Survey units were grouped each day so that between unit movements of sheep would minimally affect the counts (Table 1). Daily, survey unit groupings resulted from observations of daily movements of radiocollared sheep during research conducted from 1999-2002 (Fig. 4) (Udevitz, unpubl. data).

Survey aircraft followed elevation contours at a low altitude (≤ 150 m), targeting an optimum search intensity of 0.8 min/km² (Table 2) and attempted to observe all sheep

in the unit. The observer recorded group size and composition (i.e. ewe-like, lambs, rams by horn-size class) as well as location with the aircraft GPS. The "ewe-like" class consisted of ewes, yearlings of both sexes, and young rams (i.e. < 1/2 curl). Ram horn-size classes were 1/2, 3/4, 7/8, and full curl. Sheep that could not be identified because of terrain or aircraft limitations were categorized as "unclassified".

RESULTS and DISCUSSION

Survey Statistics

Units were surveyed on 4 days between 8 July and 15 July. Strong winds in excess of 30 km/hr prevailed throughout the early days of the survey. Four pilot-observer teams surveyed 17 of 18 units. Unit I was not surveyed. Total search time was 19.3 hrs. Survey effort averaged 0.63 min/km^2 and was not corrected for classification time. Survey units were not flown according to the optimal groupings (Table 2) so movements of sheep may have affected total counts. The net effect of sheep movements on population estimates is equivocal because during 2 previous surveys, movements resulted in a 3% under-count and a 5% over-count (Udevitz, unpubl. data).

Population Composition

Pilot-observer teams located 91 groups totaling 598 sheep (Fig. 5). Sheep groups ranged in size from 1-82 sheep ($\bar{x}$ = 6.6 sheep; median = 4 sheep). Observations of single sheep accounted for 23% of the groups sighted. The total number of sheep observed was 12% lower than the 2002 survey total. Lower numbers were also counted for adult sheep and the ewe-like class representing declines in these classes of 14%, and 10%, respectively, when compared to the last survey conducted in 2002 (Table 3). However, Unit I has averaged 30 sheep (mostly ewe-like and lambs) counted during previous surveys and may account for >30% of the observed decline. In addition, previous results from visibility bias research of radiocollared sheep indicate that sightability varies between 61% for single sheep to 95% for groups of at least 10 sheep (Udevitz, unpubl. data). Therefore, results should be evaluated as minimum estimates. Overall, it is evident that the population has remained stable in numbers, but may be in fact, still growing at a slow rate despite the lower minimum counts recorded. Used as an index of winter severity, total snowfall at Kotzebue, Alaska during winter 2003-2004 was the second highest recorded since 1949, but the immediate effect was obviously not catastrophic to the sheep population as the record snowfall was in 1990-1991 (Fig. 1). Total snowfall is a useful index, but the drastically different population effect illustrates that other weather events such as those in 1990-1991 (e.g. ground-fast ice, low temperature, and snow hardness) may be as important as this single statistic (Dau 1993).

Lamb Productivity and Survival

The number of lambs counted was slightly above the 5 year average (Table 3), but more importantly the number of lambs as a percentage of the ewe-like class was 27% and indicated strong productivity and high neonatal survival. For comparison, following the population decline (i.e. 1991-1994), this statistic averaged 14%.

Ram horn-size classes

Numeric trends in horn-size classes have been stable or increasing during the past 5 surveys (Figs. 6 and 7). The number of rams counted declined in all size classes

except for the 3/4 curl class (Figs. 6 and 7).The 41% decline in the number of 1/2 curl rams counted in 2004 was noteworthy because it could be an indicator of poor survival of young sheep of both sexes. However, because 1/2 curl rams may have been present in ewe/lamb groups, the enumeration of this horn-size class could be inaccurate. However, consecutive years of low survival of 1/2 curl rams would affect the number of large rams available for harvest in future years, so this is a horn-size class that should be monitored closely in conjunction with changes in the number of 3/4 curl rams counted. In contrast, survival of rams growing from the 1/2 curl class to 3/4 curl class was above average (Table 3). Although the number of large rams (i.e. ≥ 7/8 curl) counted were lower than 2002, the numbers counted in 2004 were equal to the 5 year averages in each size class and higher than the average number counted prior to the population decline (i.e. 51 vs.43). If ram survival remains high (i.e. in the absence of severe winters) in the 1/2 and 3/4 curl horn-size classes, then the number of large rams available for harvest would be expected to remain the same or increase in future years.

MANAGEMENT IMPLICATIONS

No significant changes in total population or composition were noted except for substantially lower numbers counted in the 1/2 curl horn-size class. Variation in sheep counted is within the error expected given visibility bias and sheep movements. Aerial surveys should continue annually using the same method until research results from the 3-year NPS/USGS study investigating survey techniques and visibility bias can be evaluated. No change of Federal Subsistence harvest quotas is recommended for the Baird Mountains.

ACKNOWLEDGMENTS

Survey data are the result of cooperative efforts between federal land managers (BLM, FWS, and NPS) and ADFG. We thank the numerous personnel and pilots that have contributed to the success of annual surveys since 1986. The 2004 survey was funded by the NPS and ADFG. Personnel from ADFG, FWS, and NPS participated as pilots and observers.

LITERATURE CITED

Ayres, L. 1986. The movement patterns and foraging ecology of Dall sheep (Ovis dalli dalli) in the Noatak National Preserve, Alaska. Thesis, University of California, Berkeley, California, USA.

Dau, J. 1993. Units 23 and 26A. Dall sheep management report. Pages 124-138 *in* S. Abbot, editor. Dall sheep management report of survey and inventory activities 1 July 1989-30 June 1992. Alaska Department of Fish and Game. Project 6.0. Juneau, Alaska.

Singer, F., D. Johnson, and R. Quimby 1983. Dall sheep numbers and distribution in the Noatak National Preserve, 1983. National Park Service, Alaska Region, Unpublished Report.

Table 1. Optimal survey unit groupings for each day of the survey. Assumes 3 survey aircraft.

Day of Survey	**Survey Unit Groupings for each of the 3 survey aircraft**		
Day 1	D, E, I	A, K, J	C, B
Day 2	M, L	F, H	P, N
Day 3	Q, R	G, O	

Table 2. Survey statistics and classification of sheep observed in each survey unit, July 2004, western Baird Mountains survey area.

Unit	Area (km^2)	Survey Day	Search Time[a] (min)	Actual Time (min)	Total	Ewes[b]	Lambs	1/2 Curl	3/4 Curl	7/8 Curl	Full Curl	Unclassified
A	129	8-Jul-04	103	73	10	5	2		1		1	1
B	104	15-Jul-04	83	65	15	9	2	1	1	1	1	
C	70	14-Jul-04	56	41	5	1		1	2	1		
D	86	8-Jul-04	69	70	14	8	5		1			
E	127	8-Jul-04	102	84	62	47	15					
F	96	15-Jul-04	77	44	38	27	10	1				
G	114	14-Jul-04	91	41								
H	127	15-Jul-04	102	117	120	51	13	17	11	11	17	
I	111		89									
J	97	8-Jul-04	78	78	37	20	4	1	9		3	
K	98	8-Jul-04	78	40	50	26	11	3	6		4	
L	115	14-Jul-04	92	83	113	55	10	1	3	1	3	40
M	121	14-Jul-04	97	112	27	11		2	9		5	
N	90	13-Jul-04	72	48								
O	93	14-Jul-04	74	61								
P	84	15-Jul-04	67	65	15	11	2			2		
Q	104	15-Jul-04	83	88	92	72	17	2			1	
R	62	15-Jul-04	50	46								
Total	**1,828**		**1,462**	**1,156**	**598**	**343**	**91**	**29**	**43**	**16**	**35**	**41**

[a] Optimal search time at 0.8 min/km^2

[b] Includes ewes, yearlings of either sex, and rams < 1/2 curl

Table 3. Summary for surveys conducted between 1998-2004. No survey was completed in 2003.

Classification of Sheep Observed	**Survey Year**						***Average***
	1998	1999	2000	2001	2002	**2004**	***1998-2002***
Rams							
1/2 curl	30	36	61	43	49	**29**	***44***
3/4 curl	16	22	21	52	29	**43**	***28***
7/8 curl	13	1	15	22	28	**16**	***16***
Full curl	57	27	10	28	54	**35**	***35***
$\geq$ 1/2 curl	116	86	107	145	157	**123**	***122***
$\geq$ 7/8 curl	70	28	25	50	79	**51**	***50***
Unclassified	0	0	0	5	1	**0**	***1***
Ewes/Lambs/Unclassified							
Ewes	289	243	317	389	381	**343**	***324***
Lambs	72	77	101	73	118	**91**	***88***
Unclassified	0	0	0	4	25	**41**	***6***
Total Sheep Counted	477	406	525	616	682	**598**	***541***

Figure 1. Total annual snowfall at Kotzebue, Alaska, 1949-1950 to 2003-2004. Source: Western Regional Climate Center.

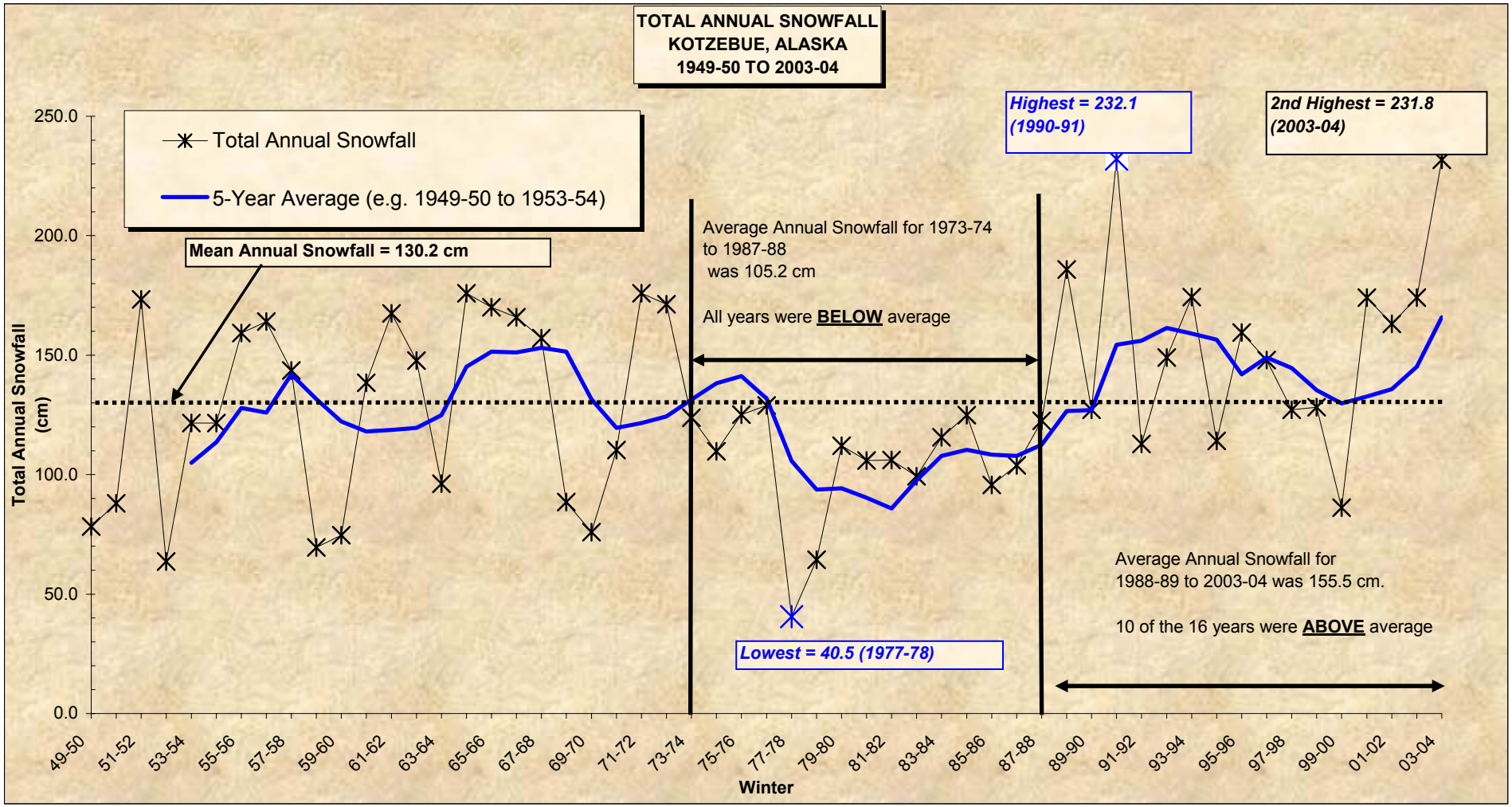


Figure 2. Adult population estimates, 1986-2004, western Baird Mountains.

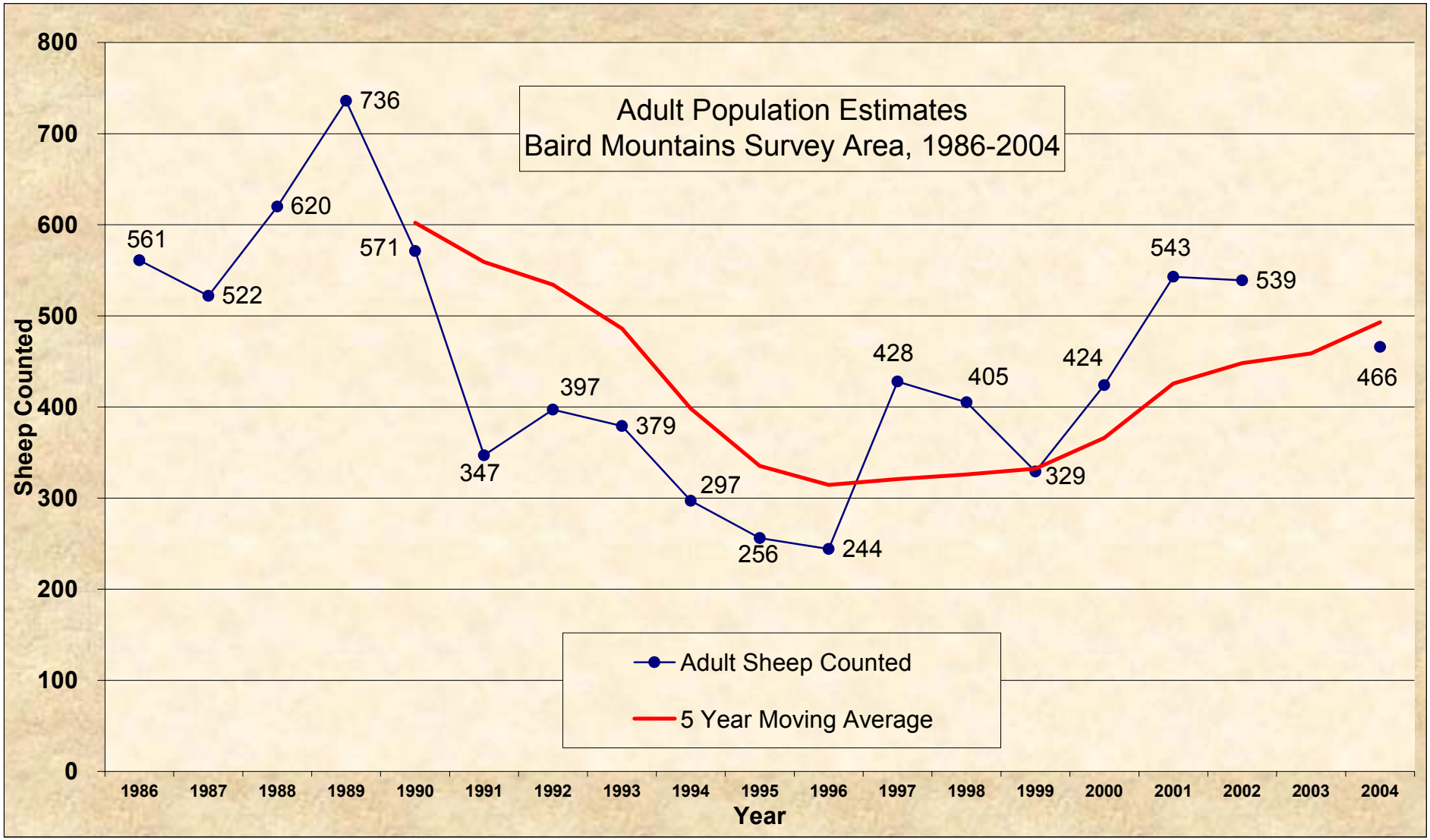


Figure 3. Western Baird Mountains sheep survey area and Western Arctic National Parklands.

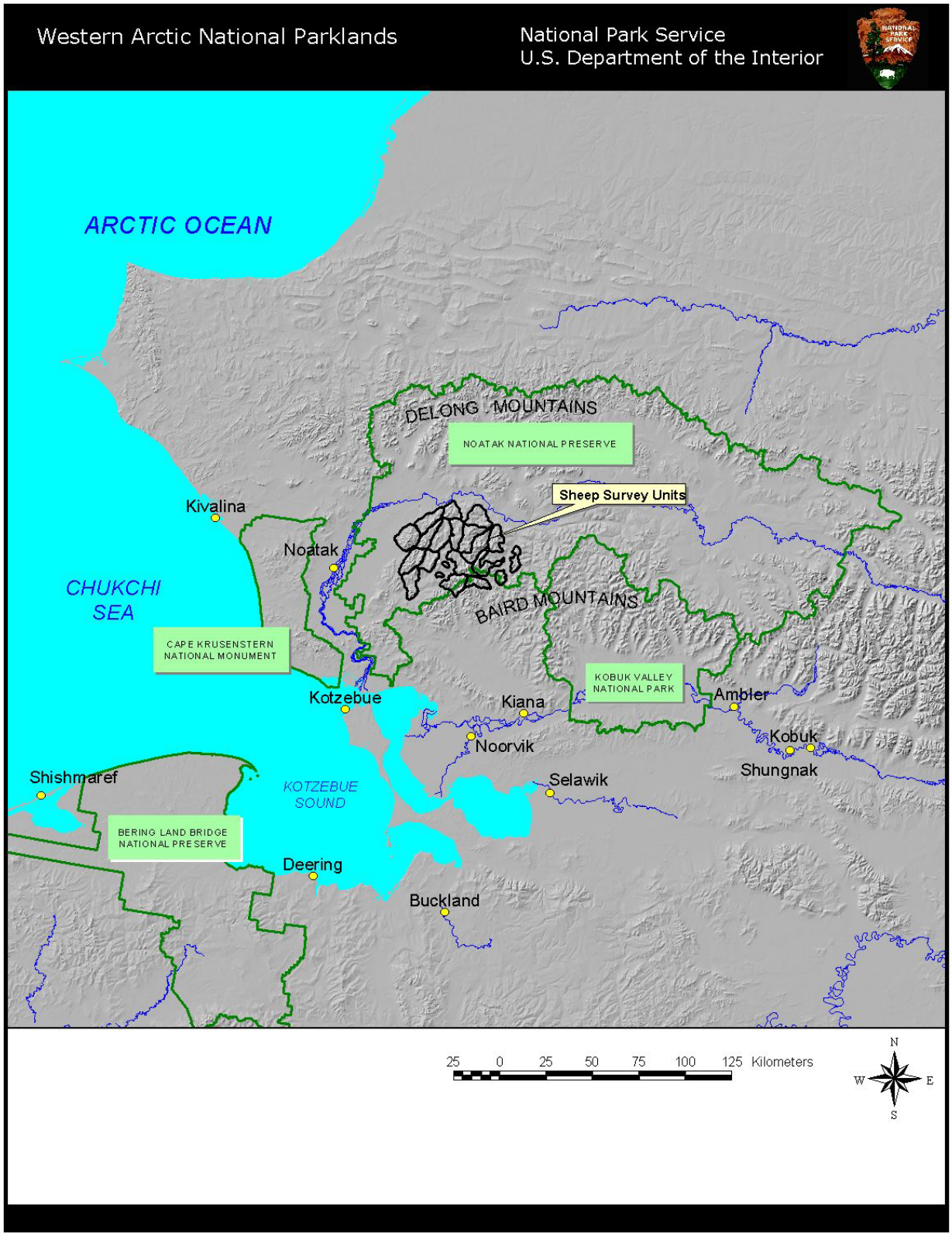


Figure 4. Movements of radiocollared sheep between survey units during previous surveys. Each line represents the movement of one radiocollared sheep during the survey period (Udevitz, upubl. data).

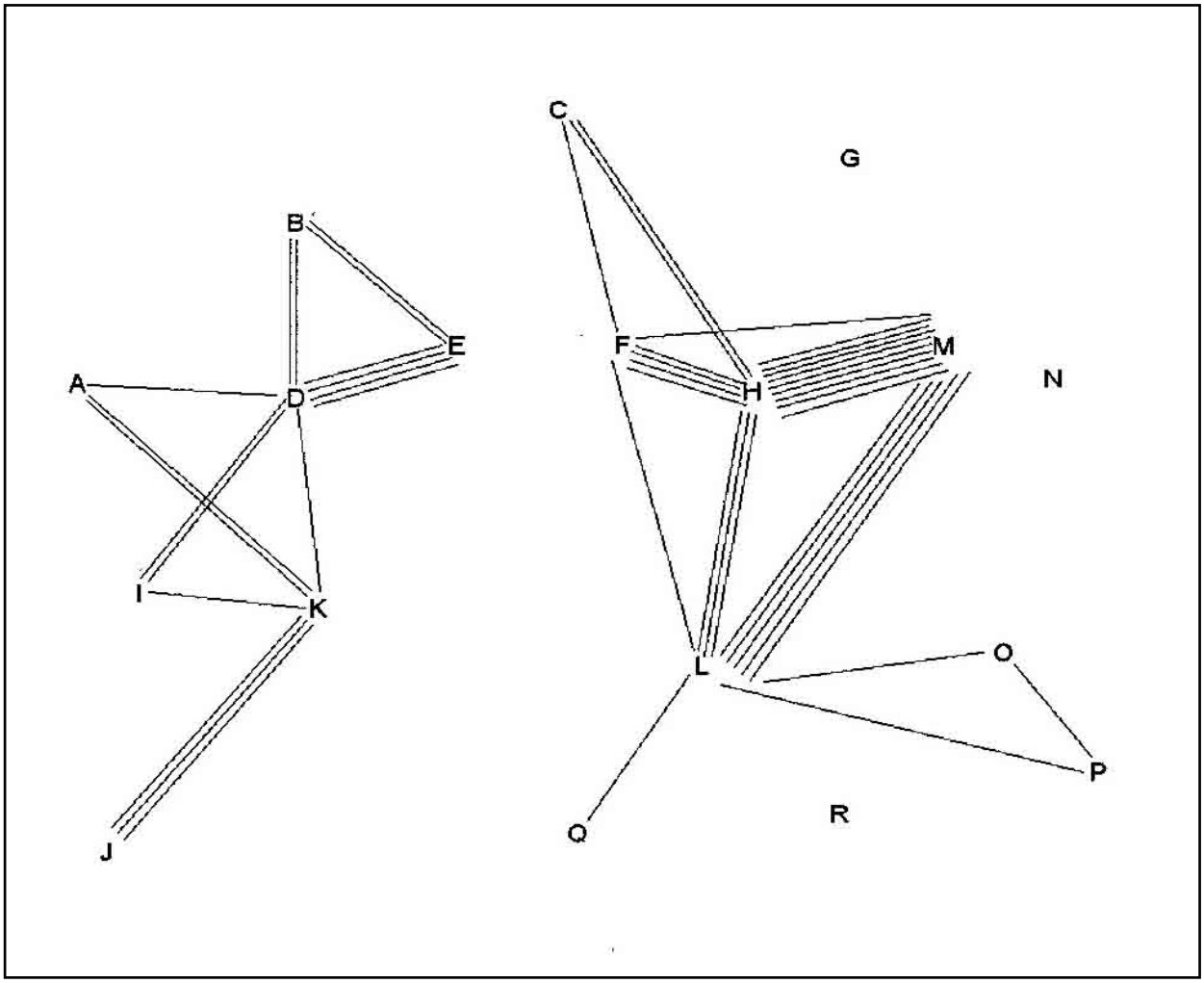


Figure 5. Locations of observed sheep groups, July 2004, western Baird Mountains survey area.

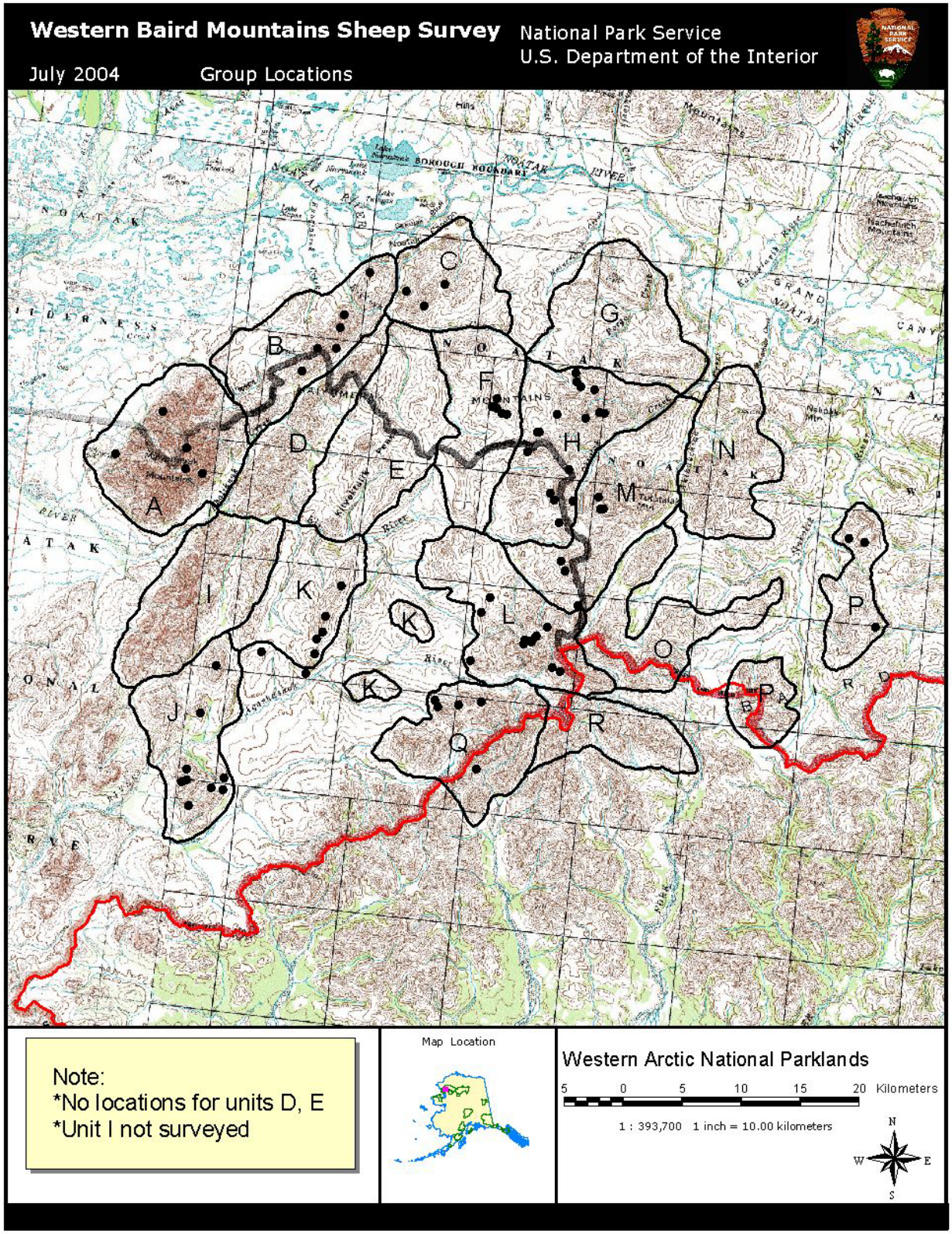
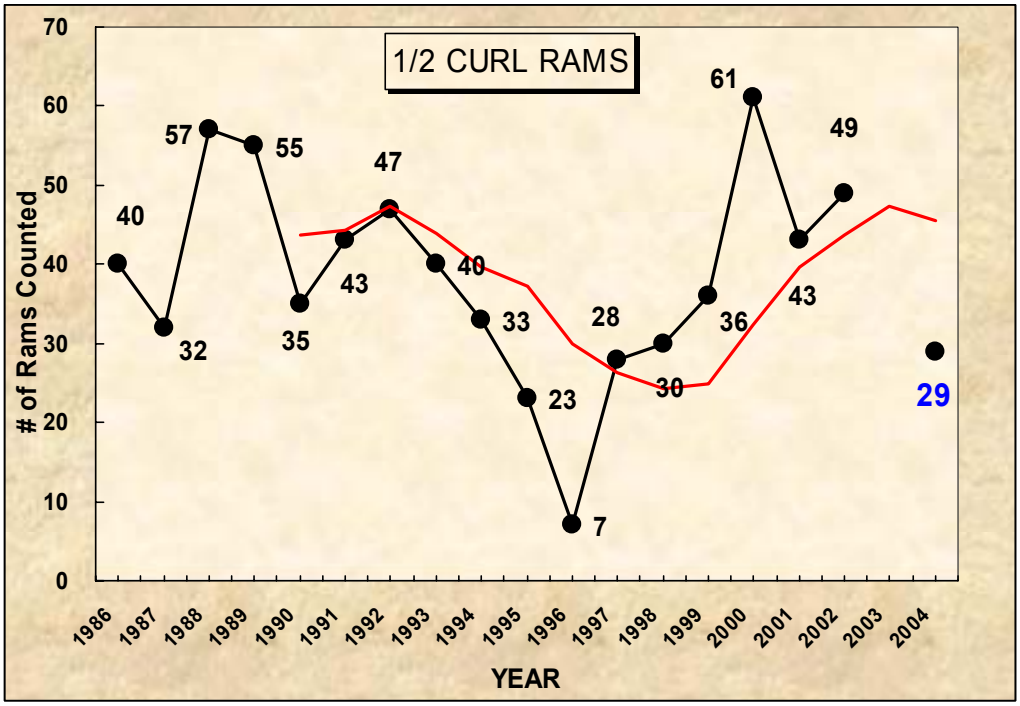
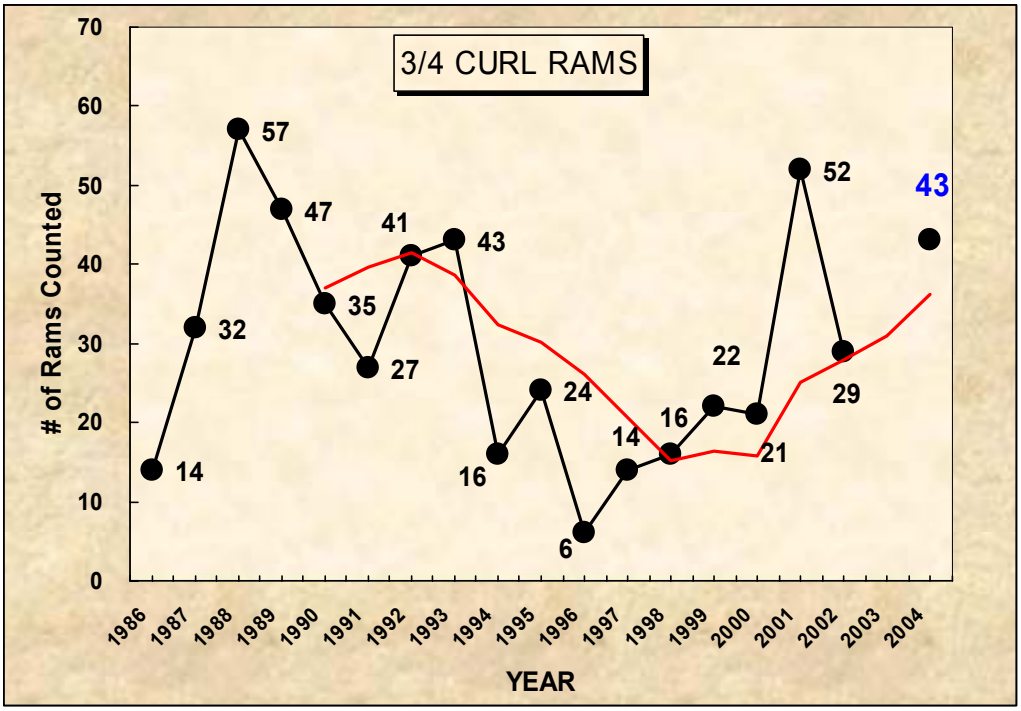


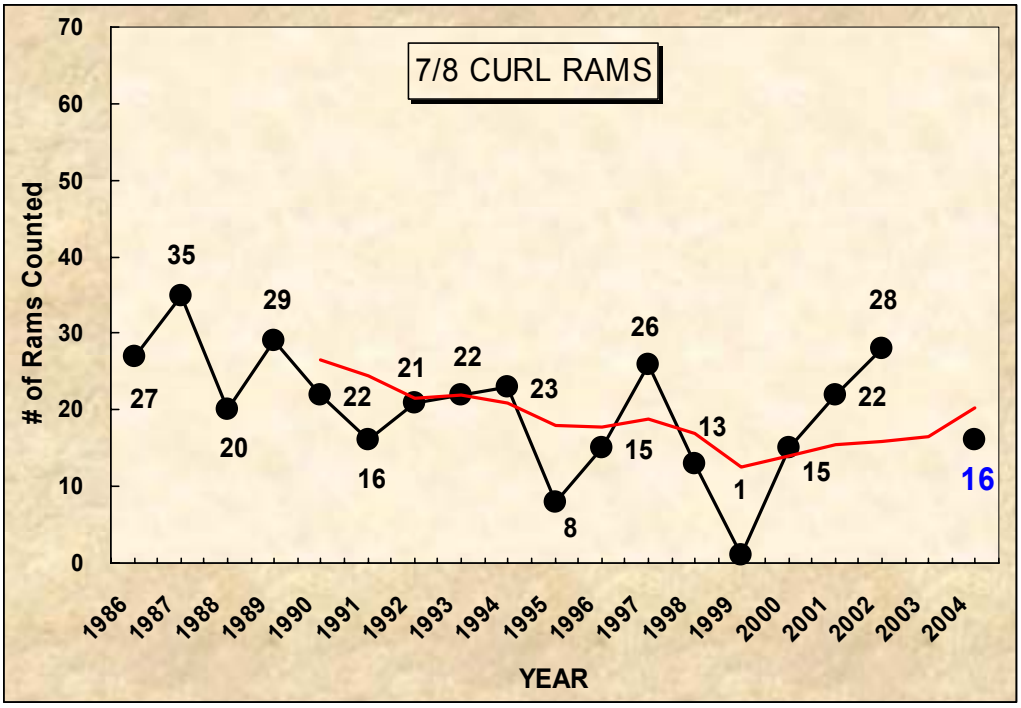
Figure 6. Number of 1/2 and 3/4 curl rams counted in the western Baird Mountains survey area 1986-2004.[a] Red line depicts 5-year moving average.

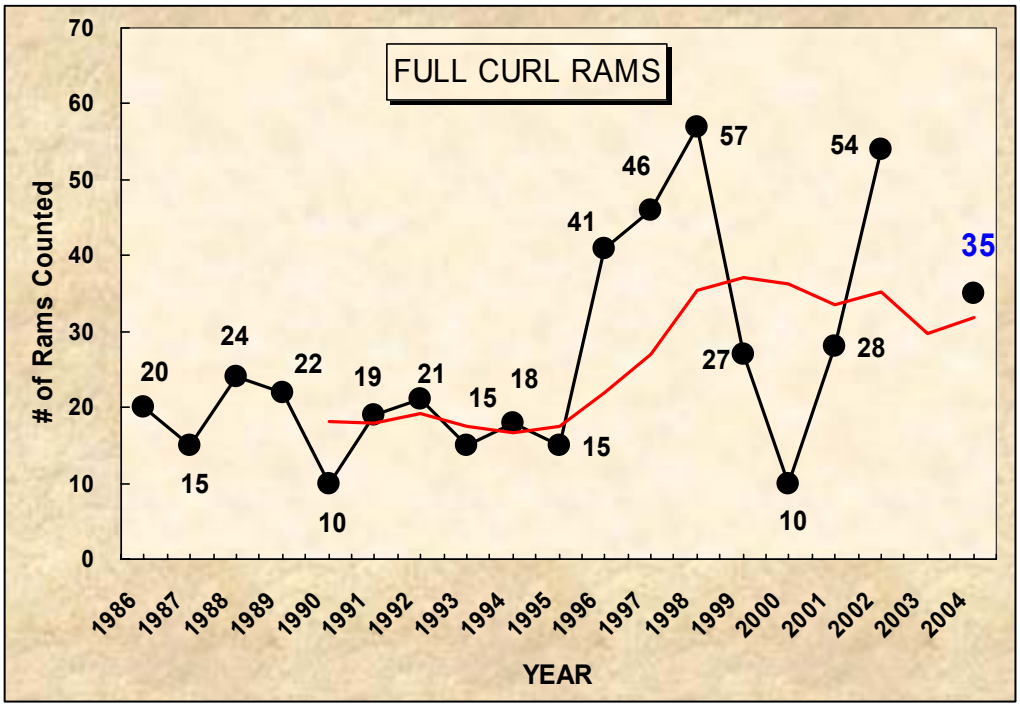




[a]No survey completed in 2003.

Figure 7. Number of 7/8 and full curl rams counted in the western Baird Mountains survey area, 1986-2004.[a] Red line depicts 5-year moving average.





[a]No survey completed in 2003.

Appendix 1. Dall's sheep population survey results, 1986-2004[a], western Baird Mountains survey area.

	1986[b]	1987[b]	1988	1989	1990	1991	1992	1993	1994
Rams ≥ 1/2 curl	145	129	136	162	105	108	130	123	93
Rams ≥ 7/8 curl[c]	47	50	35	51	32	35	42	37	41
Ewes[d]	416	393	484	574	466	239	267	256	204
Lambs	105	143	187	170	133	17	59	47	20
Unclassified	4	0	5	75	14	36	0	0	0
TOTAL	**670**	**665**	**812**	**981**	**718**	**400**	**456**	**426**	**317**
Adults[e]	561	522	620	736	571	347	397	379	297
Lambs:100 Ewes	25	36	39	30	29	7	22	18	10
Rams:100 Ewes	35	33	28	28	23	45	49	48	46
Rams ≥ 7/8:100 Ewes	11	13	7	9	7	15	16	14	20

[a] Data collected in 1,828 km^2 (765 mi^2) area using fixed-wing aircraft; No survey completed in 2003

[b] Data represent minimum counts: surveys not directly comparable to subsequent years

[c] Rams ≥ 7/8 curl are included in rams ≥ 1/2 curl

[d] Ewe defined as adult female, yearling of either sex, and <1/2 curl ram

[e] Adult defined as all sheep excluding lambs and unclassified

[f] 20 rams were not classified according to horn-size class.

[g] Preliminary minimum count data; methods comparable to previous years

[h] Unit I not surveyed

Appendix 1 Cont.

	1995	1996	1997	1998	1999	2000	2001	2002[g]	2004[h]
Rams ≥ 1/2 curl	90	75	114	116	86	107	145	157	123
Rams ≥ 7/8 curl[c]	23[f]	56	72	70	28	25	50	79	51
Ewes[d]	166	169	314	289	243	317	389	381	343
Lambs	95	58	83	72	77	101	73	118	91
Unclassified	0	0	0	0	0	0	9	25	41
TOTAL	**351**	**302**	**511**	**477**	**406**	**525**	**616**	**682**	**598**
Adults[e]	256	244	428	405	329	424	543	539	466
Lambs:100 Ewes	57	34	26	25	32	32	19	31	27
Rams:100 Ewes	54	44	36	40	35	34	37	41	36
Rams ≥ 7/8:100 Ewes	14	33	23	24	11	8	13	21	15

[a] Data collected in 1,828 km^2 (765 mi^2) area using fixed-wing aircraft; No survey completed in 2003

[b] Data represent minimum counts: surveys not directly comparable to subsequent years

[c] Rams ≥ 7/8 curl are included in rams ≥ 1/2 curl

[d] Ewe defined as adult female, yearling of either sex, and <1/2 curl ram

[e] Adult defined as all sheep excluding lambs and unclassified

[f] 20 rams were not classified according to horn-size class.

[g] Preliminary minimum count data; methods comparable to previous years

[h] Unit I not surveyed